



# Updates in NASA Policy and Practice in Planetary Protection

IEEE Aerospace Conference

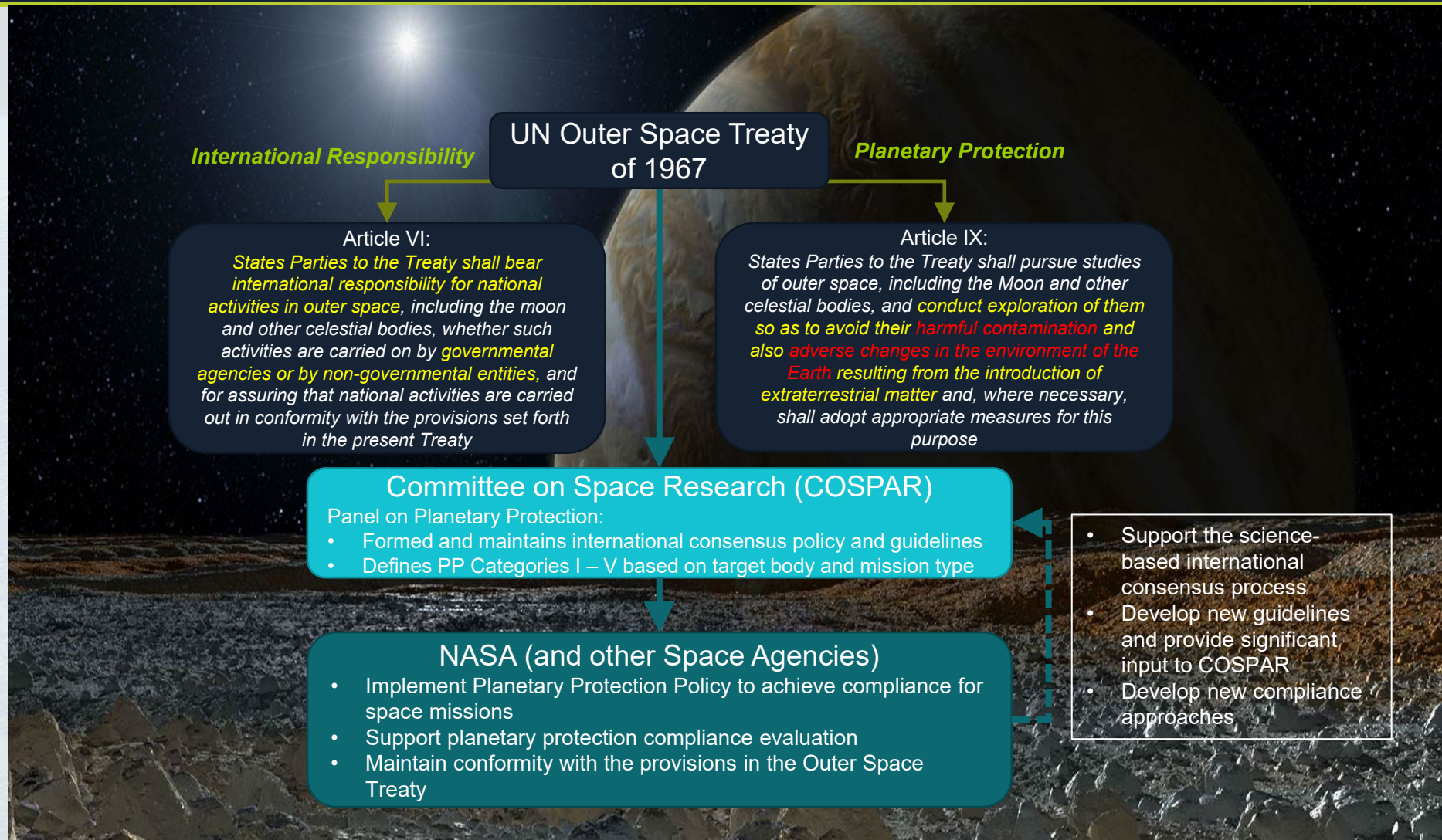
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# International Planetary Protection Process

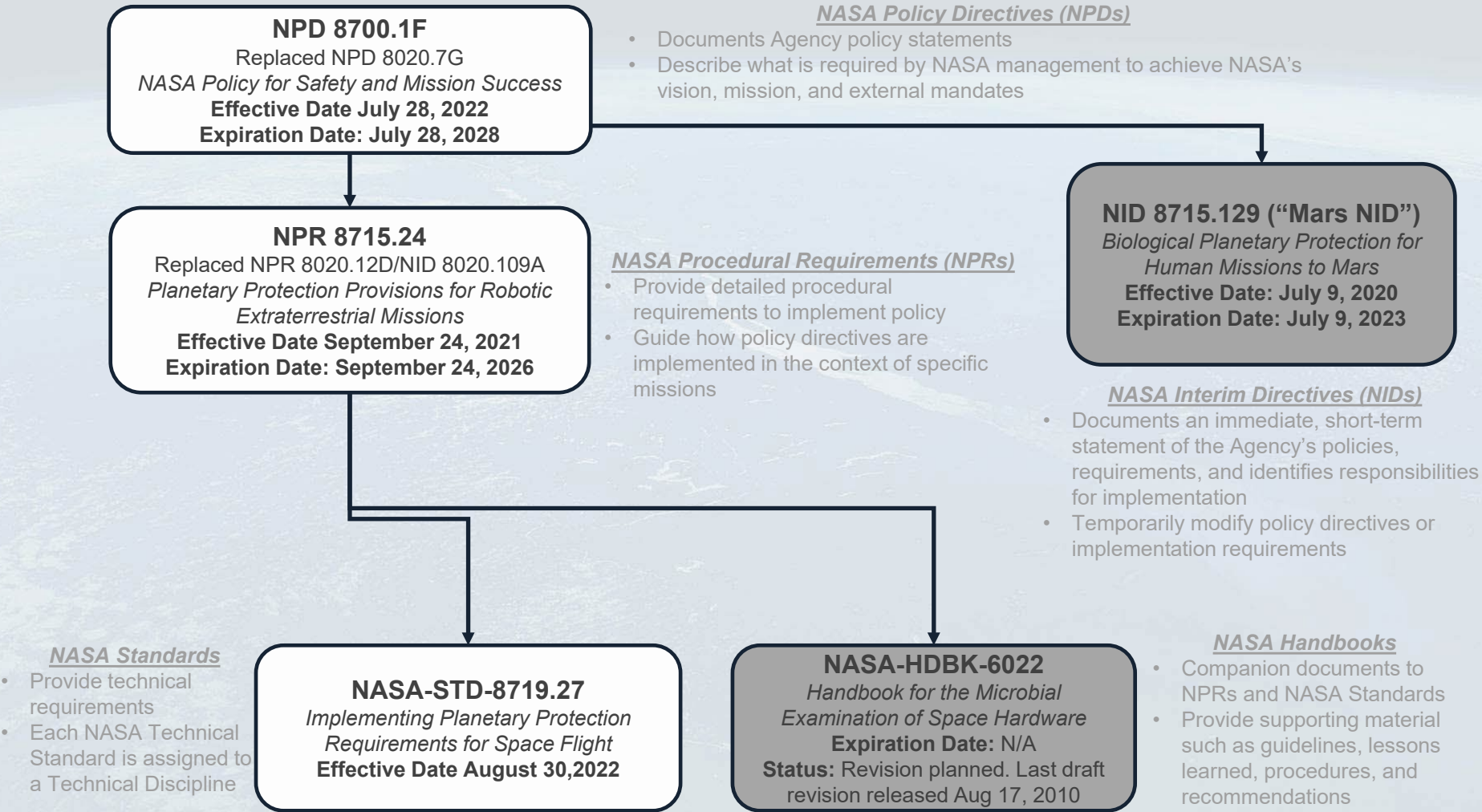




# Updates to NASA's Planetary Protection Policy Documents



Link to NASA Planetary Protection policy and guidance documents at [www.sma.nasa.gov](http://www.sma.nasa.gov)



All published documents found in NODIS: <https://nodis3.gsfc.nasa.gov/> or the OPP website: <https://sma.nasa.gov/sma-disciplines/planetary-protection#PolicyGuidance>

= Documents to be updated



## Chapter 1. Introduction

- 1.1 Overview
- 1.2 Utilization of Current Scientific Consensus Throughout the Project
- 1.3 PP Considerations for Participation in Partnered Missions
- 1.4 Delegation of Responsibilities
- 1.5 Request for Relief

## Chapter 2. Roles and Responsibilities

- 2.1 Mission Directorate Associate Administrator
- 2.2 NASA Project Manager
- 2.3 Chief, Safety and Mission Assurance
- 2.4 Planetary Protection Officer
- 2.5 Project-Level SMA Technical Authority

## Chapter 3. Planetary Protection Procedural Requirements

- 3.1 Categorization and Planning
- 3.2 Verification, Assurance, and Pre-Launch Report Activities
- 3.3 Post-Launch/End of Mission
- 3.4 Restricted Sample Return and Containment

### Chapter 1:

- Introduces risk-informed decision making
- Addresses how current scientific consensus is considered for missions
- Addresses missions with NASA partners / resources
- Baselines PP Relief using NASA General Safety Program Requirements

### Chapter 2:

- Defines the key roles and responsibilities for executing PP
  - Previously, only the PPO role was defined
  - COSPAR Interfacing
- Merges PP into the regular mission and project management structure

### Chapter 3:

- Provides the process for obtaining mission PP categorization
- Addresses PP documentation, review, and concurrence throughout the project lifecycle
- Defines independent verification/assurance activities as well as anomaly investigations
- Addresses sample return; break-the-chain (BTC), containment and process.

# NASA Standard 8719.27 – Implementing Planetary Protection Requirements for Space Flight

## 1 Scope

## 2 Applicable and Reference Documents

## 3 Acronyms and Definitions

## 4 Control of Forward Contamination

### 4.1 Purpose

### 4.2 Mission Design and Categorization

### 4.3 Biological Knowledge and Organic Contam.

### 4.4 Robotic S/C assembly, test, transport, launch & ops

### 4.5 Avoiding contam following inadvertent impact

### 4.6 Avoiding contam for robotic landed missions

### 4.7 End of mission disposition

## 5 Preclude Backward Contamination

### 5.1 Purpose

### 5.2 Cat elements for robotic and crewed Earth-Return

### 5.3 Robotic restricted-Earth return reporting reqs

### 5.4 Restricted Earth-Return implementation req

## 6 NASA Spore Assay

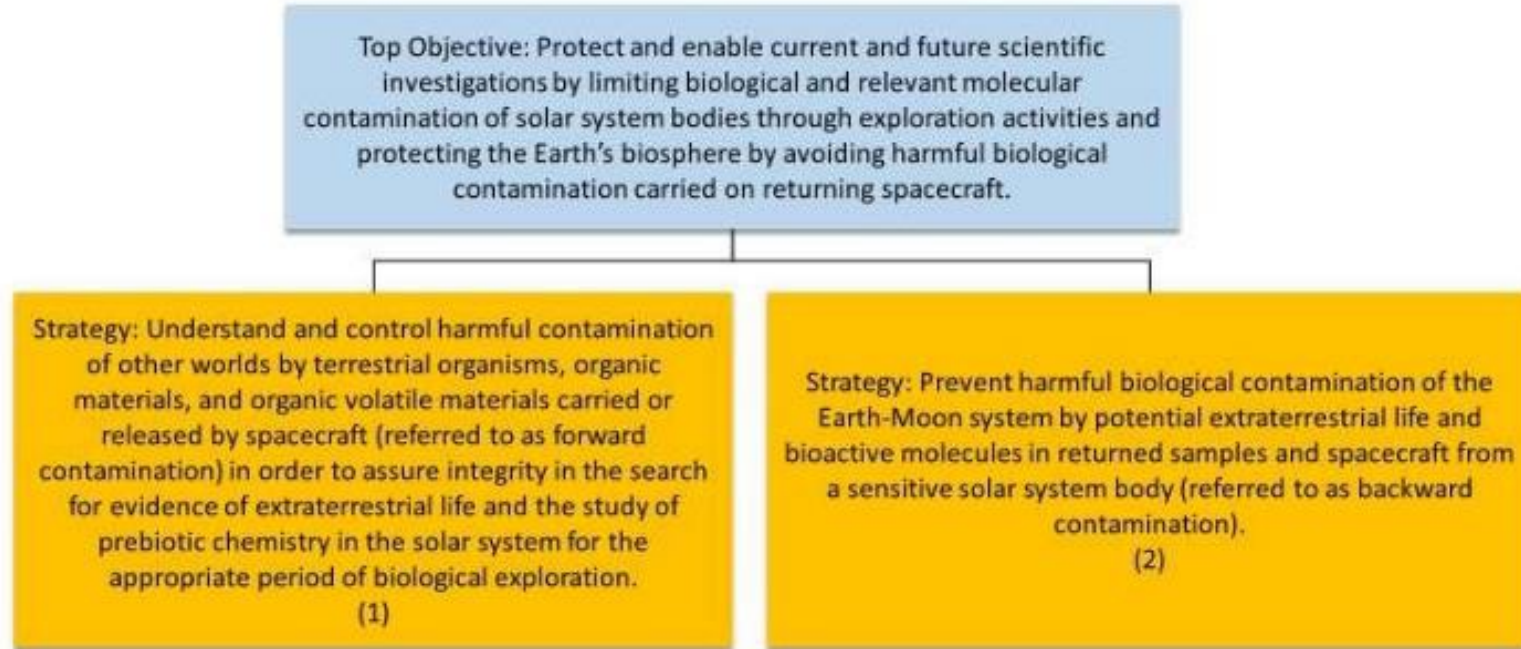
## Appendices – documentation elements, bio accounting

- Applicable to robotic and crewed missions
- Provides extensive list of recognized industry standards

- Prescriptive and performance based options
- Revised clarification of organic reporting, inadvertent impact and Mars bioburden
- Paves the way for genomic assay use

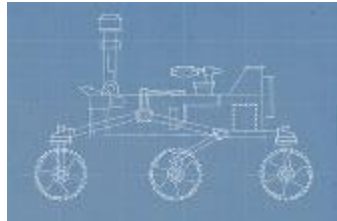
- Identifies elements required for categorization.
- Links compliance reporting to project reviews

- Added detailed technical standard due to lack of an industry standard.



## Enabling Objectives for Updated Practices

1. Transparency of operations and open communication
2. Application of best available science and scientific consensus
3. Leveraging consensus standards for implementation



## ***Mission Design & Categorization***

- Information to be included in the PP Mission Categorization Proposal
- Biological and organic contamination knowledge / materials inventory



## ***Robotic Spacecraft Assembly, Test, Transport, Launch, and Operations***

- Controlled manufacturing environments and cleanrooms
- Bioburden Control Approach
- Analytical Approach
- Documentation of requirements and communication of data/analysis updates



## ***Avoiding Contamination following Inadvertent Impact***

- Avoiding inadvertent impact of solar system bodies by spacecraft and launch elements during flyby, gravity assist, or orbital insertion
  - Jovian or Saturnian systems (Cat II)
  - Mars (Cat II-IV)
  - Sensitive Icy Worlds (Cat III or IV)
- Secondary and auxiliary payloads



## ***Avoiding Contamination for Robotic Landed Missions***

- Prevent occurrence of a biological inoculation event into a potentially habitable environment during landing and surface operations
  - Stationary and mobile activities
- Mars IVa, IVb, IVc requirements
  - Bioburden Control Approach
  - Analytical Approach
- Sensitive Icy World requirements



## ***End of Mission Disposition***

- Documentation of final disposition of hardware
- Updates to organic, biological, and combustion product inventories
- Information to be included in End of Mission PP Report





## ***Earth-Return Mission Categorization***

- Inbound categorization for Earth-return missions
  - Robotic restricted Earth-return V(r)
  - Unrestricted Earth-return V(u)
- Notional timeline for sample receiving facility (SRF) for V(r) missions.
- No further PP considerations for the return phase of V(u) missions



## ***Contamination Avoidance Prior to Earth Entry***

- **PP Requirements Document:**
  - Reports and reviews to support decision making process for Earth-return, Earth-entry, and sample release from containment
- **PP Implementation Plan:**
  - Approach to demonstrate avoidance of contamination of the Earth-Moon System
- Data and analyses used to demonstrate compliance with requirements prior to samples returning to Earth
- Containment facility readiness prior to samples returning to Earth



## ***Contamination Avoidance during Earth Containment***

- Demonstrate avoidance of harmful contamination of the Earth by preventing release of unsterilized extraterrestrial material:
  - At landing site
  - During transport
  - During storage, curation, and sample safety assessment activities



## ***Sample Safety Assessment***

- Sample sterilization to inactivate terrestrial bioactive molecules
- Strategies to avoid “false positives” and “false negatives” in life detection investigations or sample safety assessments
- **Sample Pre-Release Report:**
  - Approach to demonstrate avoidance of contamination of Earth
  - Feeds into the decision-making process for releasing samples out of containment



# Updated Practices



- The planetary protection process has been re-normalized with NASA programmatic and system engineering practices

- PP Categorization
- PP Requirements Document

PP Implementation Plan

PP End of Mission Report

PP Post-Launch Report

PP Pre-Launch Report

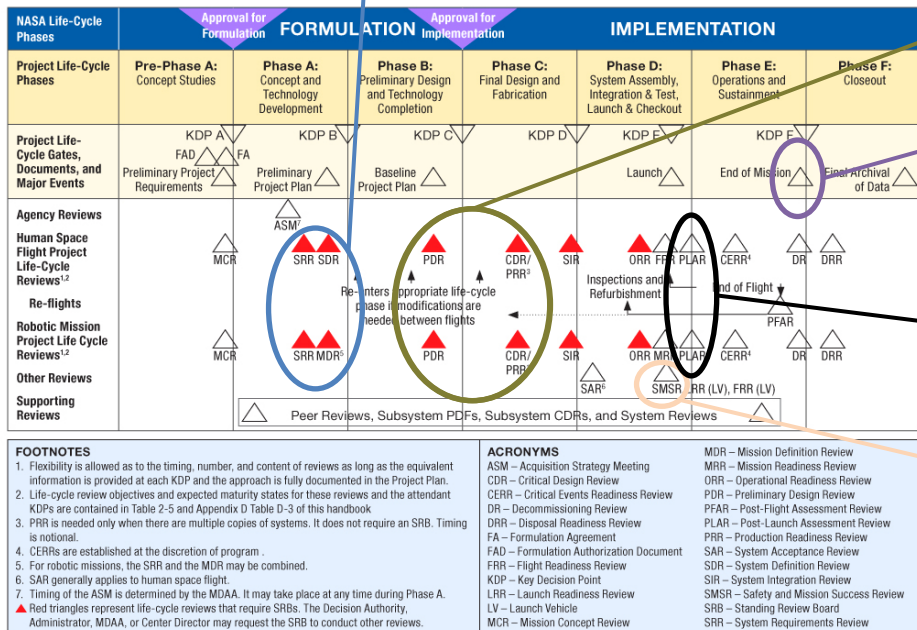
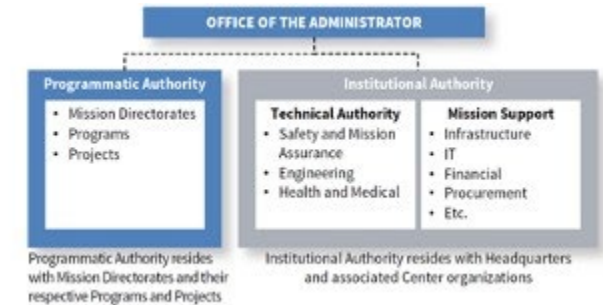


FIGURE 3.0-1 NASA Space Flight Project Life Cycle from NPR 7120.5E

NOTE: Projects propose documentation and schedule



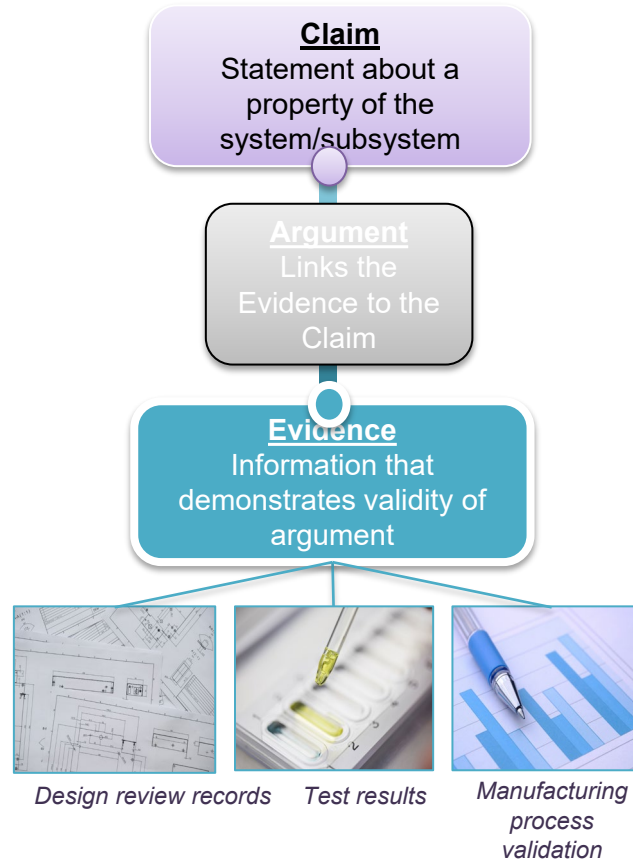
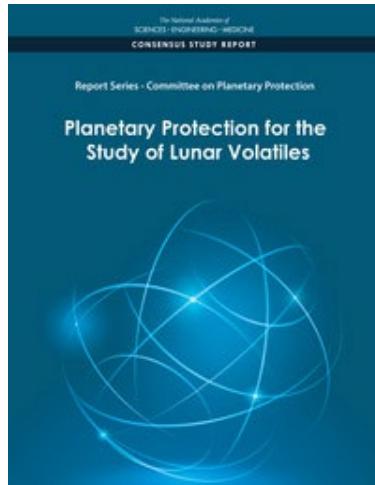
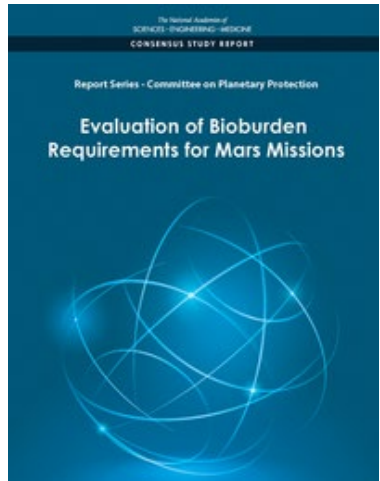
## Programmatic

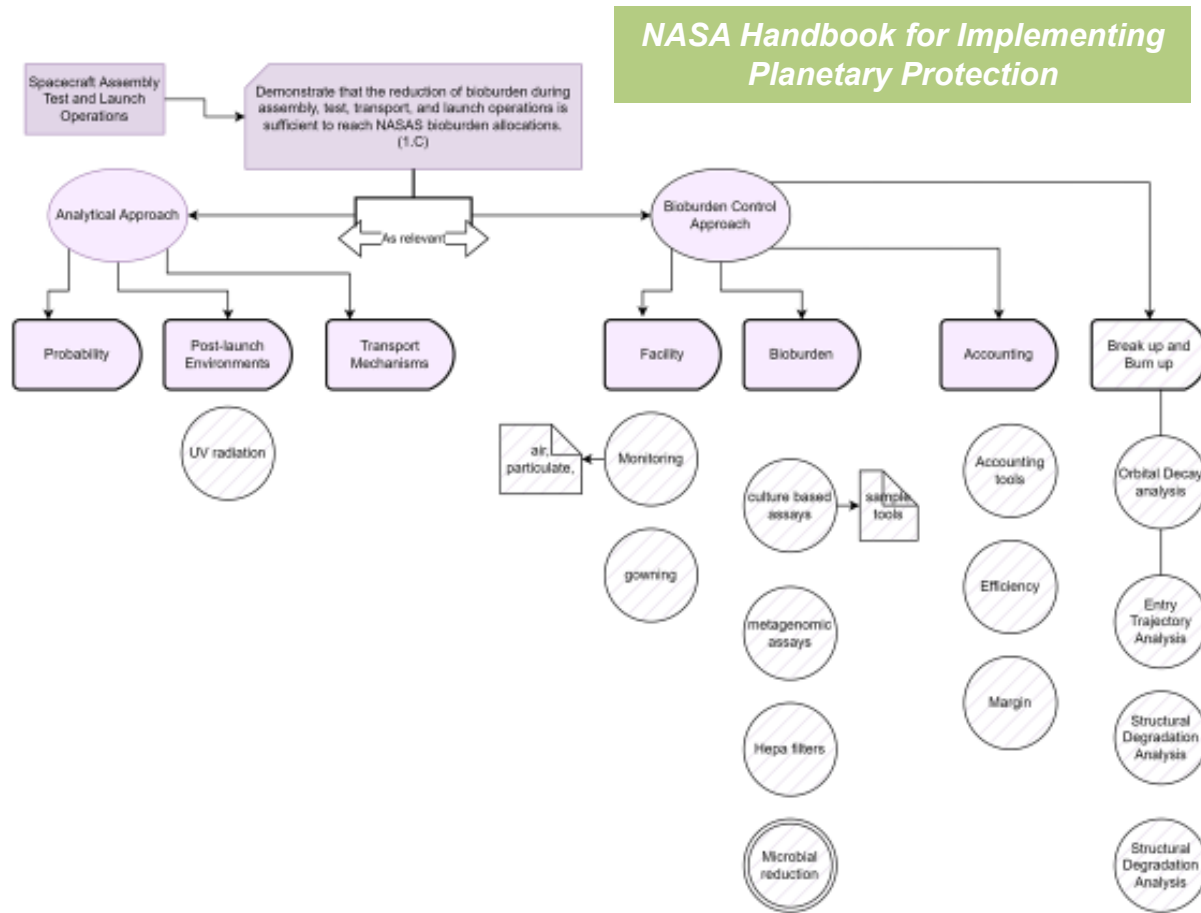
- Proposes and issues PP category
- Identifies applicable requirements
- Conducts closed loop requirements verification
- Establishment and execution of compliant implementation
- Reporting (to NASA)

## Safety and Mission Assurance TA

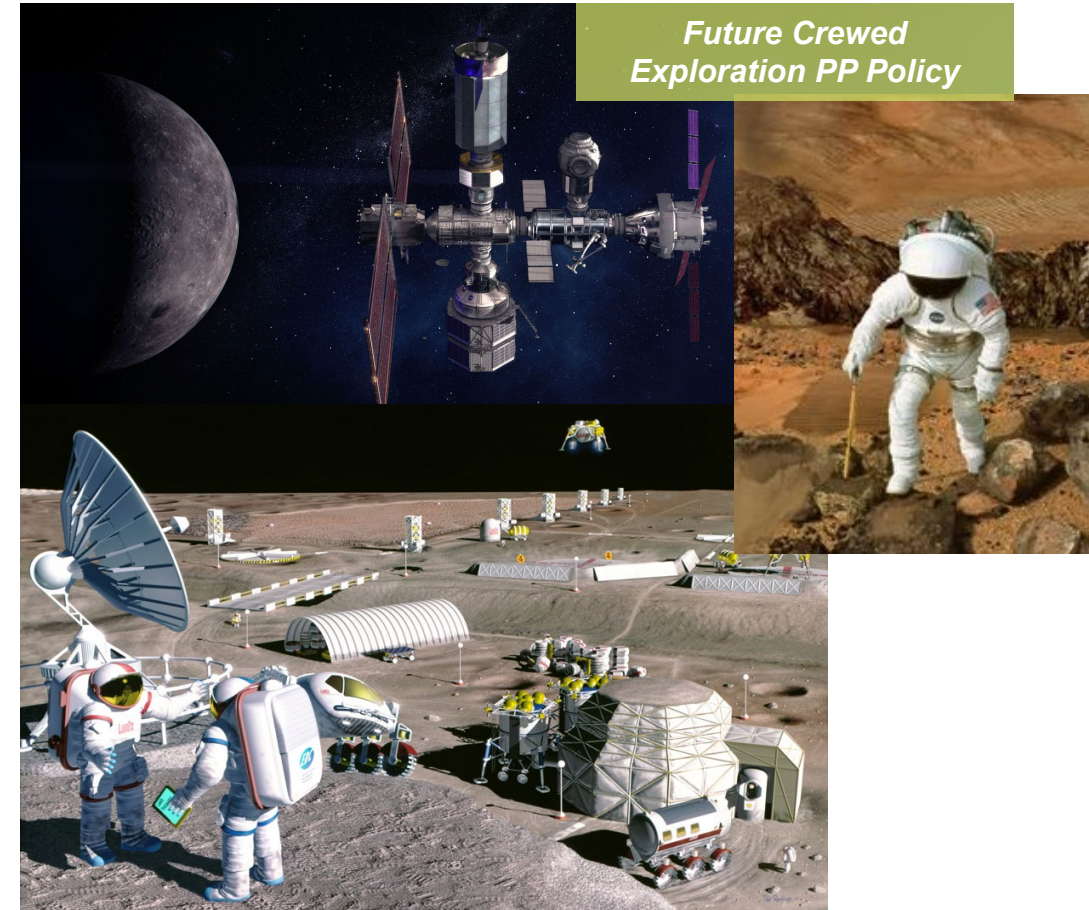
- Concurs PP Categorization
- Confirms adequacy of requirements implementation approach
- Verification of implementation compliance
- Reporting (to COSPAR for NASA)

- Application of best available science and scientific consensus
- Leveraging consensus standards for implementation
- Adoption of performance-based requirements





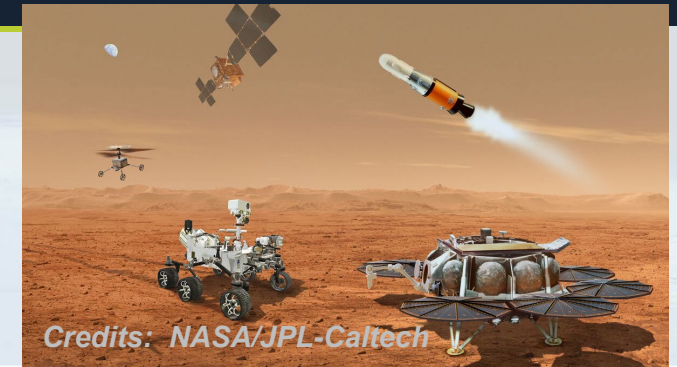
- Major revision of handbook to an online format to include all PP implementation topics (opposed to NASA HBK-6022 addressing only biological contamination).



- Establish NPR for Crewed Moon and Mars missions
- As knowledge gaps close NASA STD 8719.27 will be updated to include technical crew requirements.



# Requirements and Implementation for a Sample Return Mission



	Moon	Mars
Forward Categorization	IIa or IIb	IVb
Sample Return Categorization	Unrestricted Earth-Return	Restricted Earth Return
United States Government Notification	Awareness of activity as best practice	Mandatory; approval from White House
Spacecraft Bioburden Management prior to Launch	Not Applicable	Yes
Sample Biosafety Approach	Not Applicable	Yes
Sample Containment	Not unless required for science	Yes
Break-the-chain with target body	Not Applicable	Yes
Biocontainment for Earth ground transportation	Not Applicable	Yes
Biocontainment to protect Earth's biosphere	Not Applicable	Yes
Curation facility to protect science	Yes	Yes
Sterilization or Sample Safety Assessment for evidence of extant extraterrestrial life prior to release	Not Applicable	Yes
Mission reporting of samples brought back to Earth	Yes	Yes





# Questions?

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